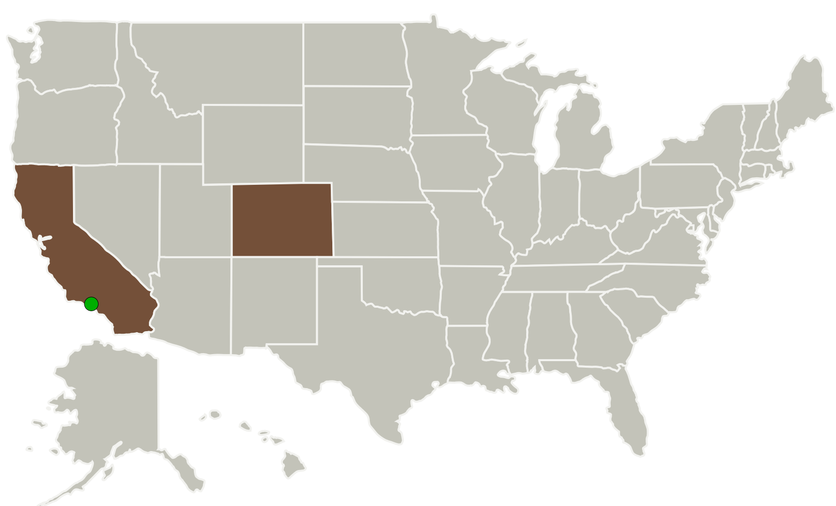
Balancing Autonomous Spacecraft Activity Control with an Integrated Scheduler-Planner and Reactive Executive, Phase II

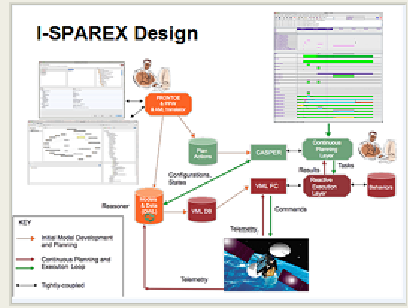
Completed Technology Project (2014 - 2017)

Project Introduction

Spacecraft and remote vehicle operations demand a high level of responsiveness in dynamic environments. During operations it is possible for unexpected events and anomalies to disrupt the mission schedule, and in the case of critical faults, even threaten the health and safety of the spacecraft. The planner's relatively slow response time to unexpected events (changes in resource levels, failed activity indications, flight software fault indications) during dynamic and critical operations means that it does not suffice as a sole solution to the vehicle autonomy when the primary purpose is to keep it safe and ensure mission success. Mission success can also be enhanced through the use of a sequence engine that provides reactive capabilities. Traditional sequence engines execute commands without regard to the overall safety of the vehicle. Through the use of a reactive sequence engine that utilizes State Machine technology vehicle further enhances safety and the probability of mission success. The Integrated Scheduler-Planner And Reactive Executive (I-SPAREX) architecture utilizes a layered software architecture (an approach proven successful on previously flown autonomous demonstration missions such as EO-1) and incorporates an existing goal-based, planning solution as well as an advanced, real-time, decision-making sequence engine. Specifically, we plan to study and demonstrate the feasibility of integrating NASA JPL's CASPER (Continuous Activity Scheduling Planning Execution and Re-planning) as the Continuous Planning Layer (CPL), and VML 3.0 (Virtual Machine Language) as the Reactive Sequencing Layer (RSL) providing programmable heuristic control. We choose to focus on CASPER and VML in this proposal, given the demonstrated flight heritage of both components.

Primary U.S. Work Locations and Key Partners





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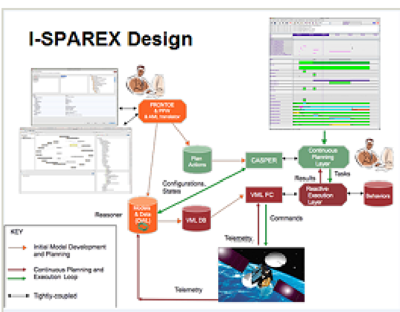
Organizations Performing Work	Role	Type	Location
Red Canyon Software	Lead Organization	Industry Historically Underutilized Business Zones (HUBZones)	Denver, Colorado
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Colorado

Images



Briefing Chart Image
Balancing Autonomous Spacecraft Activity Control with an Integrated Scheduler-Planner and Reactive Executive, Phase II
(https://techport.nasa.gov/image/128696)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Red Canyon Software

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

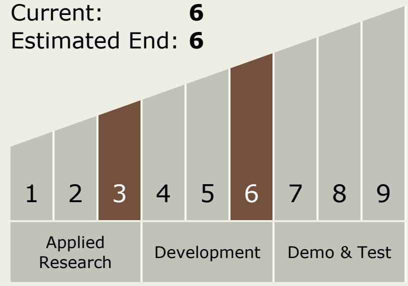
Caroline Chouinard

Co-Investigator:

Caroline M Chouinard

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX10 Autonomous Systems
  └ TX10.2 Reasoning and Acting
    └ TX10.2.4 Execution and Control

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System